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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

TITLE:           PORTABLE       STRIPPING       HEAD  
                  INDUCTION HEATING SYSTEM FOR  
                  STRIPPING COATED AND LINED  
                  METAL OBJECTS AND SURFACES AND  
                  METHODS FOR STRIPPING COATED  
                  METAL OBJECTS AND SURFACES

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## BACKGROUND OF THE INVENTION

### 1. Field of The Invention

The present invention relates to electromagnetic apparatuses and processes which utilize or effect induction heating.

### 2. Background Information

Many industrial components and vessels are coated, painted or protectively encapsulated for somehow preventing chemical or environmental damage to physical assets, or, in some cases, to enable the items to perform their intended function.

A particularly pertinent example of a coated item which relates to the present invention is that of a rubber-lined railroad tank car, or similarly lined tank trailer for tractor trailer use and storage tanks. Caustic chemicals cannot be stored, shipped or transferred using bare metal components or containers. Therefore, metal tanks and railroad tank cars as are used to maintain or convey such chemicals are coated with thick layers of rubber and rubber-like protective materials. The same treatment is given pipes and fittings as are used in

1 connection with transferring caustics to and from containers  
2 and conveyances.

3 As effective as rubber linings and coatings are in  
4 protecting the metal of the above-referenced metal items, the  
5 coatings' service life is limited. Degradation over time, as  
6 well as physical damage (nicks, tears, etc.) require replacing  
7 the coatings, if the underlying metal is to be adequately  
8 protected. Ordinarily, such coatings cannot be patched or  
9 otherwise repaired, and the existing coating must be  
10 completely removed and replaced with a completely new coating.

11 Removing existing coatings from industrial coated parts  
12 is very time consuming and expensive. Preliminary tests  
13 involving the removal of approximately 1/3 of the rubber  
14 lining of a conventional railroad tank car consumed only 16  
15 hours of labor using the system of the present invention.  
16 Conversely, this same process consumed approximately 55 worker  
17 hours when using conventional methods. In addition to time  
18 parameters, the present methods for removing such linings each  
19 present serious health and/or environmental issues. Further  
20 still, by so reducing time consumption for such major jobs as  
21 railroad tank car stripping, workers are freed to work on  
22 other projects (only one worker can strip a railcar tank in

1 two working days, versus the usual three or four workers  
2 needed to turn around the job within normal time parameters.

3 One present method for removing such linings is by  
4 burning the lining through use of blow torches, which produces  
5 toxic fumes and emissions. Another method involves simply  
6 chiseling the lining away with associated worker risks, and  
7 enormous time consumption. Certain chemicals can be used to  
8 dissolve or disengage rubber linings, but this also produces  
9 toxic byproducts, and are hazardous to users, both in terms of  
10 vapors and direct physical contact. Still other methods  
11 (applicable in most cases only to small components) include  
12 hydroblasting components or freezing the components (a small  
13 fitting, etc.) and hammering the then-brittle coating to break  
14 it free. Hydroblasting involves maintenance intensive  
15 equipment, and hammering or chiseling tends to damage many  
16 components, including by gouging metal which cannot, before  
17 substantial repair, be again exposed to caustic chemicals.

18 It would be highly beneficial to industries involved in  
19 the use, manufacture or repair of coated metallic structures  
20 and devices to provide an apparatus and associated methodology  
21 for quickly and safely removing coatings from such structures  
22 and devices. Such a device and method would ideally be  
23 applicable to the removal of chemical-resistant rubber

1 coatings, as well as to the removal of paints and even  
2 labeling materials.  
3

#### 4 SUMMARY OF THE INVENTION

5 It is an object of the present invention to provide an  
6 apparatus for more quickly removing protective coatings and  
7 linings from metallic structures than is presently,  
8 economically feasible.

9 It is another object of the present invention to provide  
10 an apparatus for quickly disengaging protective coatings and  
11 linings from metallic structures.

12 It is another object of the present invention to provide  
13 an apparatus for quickly disengaging protective coatings and  
14 linings from metallic structures, without the use of chemical  
15 agents, open flames, or physical impacting.

16 It is another object of the present invention to provide  
17 a method for quickly disengaging protective coatings and  
18 linings from metallic structures for easy removal, which  
19 method involves inductive heating.

20 It is another object of the present invention to provide  
21 a method for quickly disengaging protective coatings and  
22 linings from metallic structures for easy removal, which  
23 method obviates the need for chemical stripping agents, open

1 flames, and physical impacting of the structures in removing  
2 such coatings or linings.

3 It is another object of the present invention to provide  
4 a portable induction heating apparatus which is useful in  
5 disengaging protective coatings and linings from metallic  
6 structures for easy removal.

7 In satisfaction of the above objects, the present  
8 invention provides a portable stripping head induction heating  
9 apparatus and associated method of use thereof which apparatus  
10 and method is useful in heating metallic components to which  
11 protective coatings or linings are applied for enabling their  
12 easy removal. The apparatus as described herein has use in  
13 situations where conventional induction furnaces would have no  
14 possible use, in many cases, because the item to be "stripped"  
15 cannot be placed within an induction oven. The portability of  
16 the stripping head portion of the system described herein  
17 enables the use of induction heating for coatings and linings  
18 removal in contexts never before realized or practiced in the  
19 relevant industries.

20 Through use of the presently described apparatus and  
21 associated methods, the present inventor has successfully  
22 reduced the worker hours to strip approximately 1/3 of a  
23 railroad tank car from over 50 hours to 16 hours. Small metal

1 fittings which required two hours or more to hand strip have  
2 been stripped in six minutes using the present Inventor's  
3 apparatus and method. Comparable reductions and worker hours  
4 have been realized in stripping operations of other metallic,  
5 coated or lined items or surfaces.

6 The cost savings alone from use of the present invention  
7 by the chemical industry (chemical transporters in particular)  
8 will easily exceeds millions of dollars each year. In  
9 addition, workers who use the present method and equipment in  
10 lieu of chemical, open flame, or physical impact methods will  
11 be spared health and safety hazards.

12 The present equipment and methods may be simple, but they  
13 are certainly not obvious, else industry would already be  
14 enjoying the astounding benefits.

#### 15 16 BRIEF DESCRIPTION OF THE DRAWINGS

17 Fig. 1 is a perspective view of the general configuration  
18 of an induction heating stripping system of the present  
19 invention (less the stripping head portion) and includes the  
20 electrical power supply, the primary electrical leads, the  
21 capacitors, and the secondary leads.

1           Fig. 2 is a perspective view of a loose coil  
2 configuration for a stripping head for use in the present  
3 invention.

4           Fig. 3 is a perspective view of a rigid coil  
5 configuration for a stripping head for use in the present  
6 invention, which coil is configured of round copper tubing and  
7 includes concentrator material for focusing the induction  
8 energy upon the to-be-stripped, coated or lined surface or  
9 item.

10          Fig. 4 is a perspective view of a rigid coil  
11 configuration for a stripping head for use in the present  
12 invention, which coil is configured of flat with a copper  
13 tubing and includes concentrator material for focusing the  
14 induction energy upon the to-be-stripped, coated or lined  
15 surface or item.

#### 16 17           DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

18          The present invention includes methods for stripping  
19 protective coatings or linings from metallic items or surfaces  
20 as well as the systems which are assembled for carrying out  
21 such methods.

22          The present portable stripping head induction heating  
23 system may be assembled from components which are readily

1 available from electrical equipment and supply distributors.  
2 Actual assembly of the system, however, should be performed by  
3 persons well familiar with safety concerns when dealing with  
4 high voltage and amperage electricity.

5 The present inventor has endeavored to provide what is  
6 now believed to be the preferred embodiment and best mode of  
7 the present invention, however, due to the simplicity of the  
8 assembled system, many variations and/or substitutions with  
9 respect to individual components may be made, while still  
10 practicing the present invention. A description of the  
11 presently believed preferred embodiment follows.

12 Referring to Fig. 1, the basic components of the portable  
13 stripping head induction heating system 10 of the present  
14 invention include: (1) a power supply 12; (2) primary leads  
15 14; (3) capacitors 16; (4) secondary leads 18; and (5)  
16 stripping heads or coils (20, 22, or 24 as will be described  
17 hereafter).

18 For safety and cooling purposes, primary leads 14,  
19 secondary leads 18, and the conducting rod or cable which form  
20 the coils in stripping heads 20, 22, or 24, are all , in the  
21 preferred embodiment, enveloped in nonconductive water hose-  
22 like tubing 26, and water it is forced through the tubing 26  
23 during use of the system 10 to cool all electrically

1 conducting elements. Water flows into one "side" of the  
2 system, circulates all the way to the distal end of the coil  
3 in each stripping head, and returns to near the origin in the  
4 other side of the system, carrying excess heat with it. In  
5 alternative embodiments (if the stripping head does not  
6 receive water cooling, or is cooled separately from the leads'  
7 coolant supply), primary and secondary leads lie within  
8 coolant conduits, and either the coolant (water, usually)  
9 exits near the juncture between the primary lead and the  
10 stripping head, or flows from one to the other secondary lead  
11 in a bypass conduit (not shown in the drawings).

12 The respective junctions between leads 14 and 18 with  
13 capacitors 16 and with stripping heads 20, 22, or 24 are  
14 ideally achieved through use of compression fittings 28 which  
15 are soldered or brazed onto the leads (cable). Tubing 26 is  
16 then clamped onto fittings 28 using suitable clamps (not  
17 separately shown in the drawings) for achieving a liquid seal  
18 between the tubing 26 and the fitting 28. Of course, tubing  
19 26 includes such inlet and outlet orifices or valves as are  
20 appropriate to the desired coolant flow circuit, depending on  
21 those portions of system 10 which are to be liquid cooled.

22 The power supply 12 chosen for the preferred embodiment  
23 of the present invention is presently a 75 kW, 10 kHz

1 frequency, 480 volt unit. The capacitors are 450 KVAR (10,000  
2 cycles per second) which are encapsulated in a nonconductive  
3 plastic box.

4 Leads 14 and 18 are, in the preferred embodiment,  
5 constructed of #2 copper wire rope. Primary leads 14, in the  
6 presently preferred embodiment, are 80 feet in length, while  
7 secondary leads 18 are 20 feet in length. Of course, any  
8 electrically conductive material can be used in substitution  
9 for the copper herein prescribed, provided such conducts  
10 sufficiently well conduct (as in the case of the leads) and to  
11 exhibit the magnetic coil characteristics while under power  
12 (as in the case of the coils in the stripping heads),  
13 substantially as would the copper materials assembled as  
14 described herein.

15 The two capacitors to 16 intervene the primary and  
16 secondary leads 14 and 18 and provide the current dynamics  
17 which generate the magnetic fields necessary to induce the  
18 metallic heating as is a primary focus of the present  
19 invention.

20 Three primary stripping head configurations have been  
21 conceived and successfully tested to date. Referring to Fig.  
22 2, stripping head 20 merely comprises a 10 foot length of #2  
23 copper wire rope (encapsulated in more tubing 26, in the

1 preferred embodiment) which can be merely wrapped around or  
2 placed on that which is to be stripped. As with all junctures  
3 between stripping heads and secondary leads 18 in a preferred  
4 embodiment of the present invention, compression fittings 28  
5 provide the juncture between stripping head 20 and secondary  
6 leads 18.

7 Referring to Fig. 3, stripping head 22 is configured into  
8 a rigid coil structure and is constructed of 3/8 inch copper  
9 tubing which is 10 feet in length. The copper tubing of  
10 stripping head 22 is encapsulated by rubber, plastic, or  
11 fiberglass to insulate adjoining lengths of tubing from each  
12 other and to mechanically and electrically isolate the tubing  
13 from that which is being stripped. The back face 30 of  
14 stripping head 22 (the face away from that which faces the to-  
15 be-stripped item or surface) is overlain by a sheet of  
16 concentrator material 32 which is available from electrical  
17 supply and induction companies. The concentrator material 32  
18 helps direct the induction energy toward the desired target  
19 and is a familiar material in the induction heating field.

20 Referring to Fig. 4, stripping head 24 is somewhat  
21 similar in concept to stripping head 22, however, the copper  
22 tubing for stripping head 24 is 3/8 inch square tubing, rather  
23 than round tubing as in stripping head 22. Experimentation

1 has shown that use of such square tubing effects a much more  
2 efficient focusing of the induction energy toward a to-be-  
3 stripped surface or item than can be achieved when using round  
4 tubing, thus heating of a to-be-stripped item or surface  
5 occurs much more quickly when using this configuration. As  
6 with stripping head 22, stripping head 24 includes a sheet of  
7 concentrator material 32 which overlies the back face of the  
8 head, and a sheet of fiberglass or other insulative/protective  
9 material overlays the front face of stripping head 24.

10 A tremendous advantage which is realized through use of  
11 any system of the present invention is that the item or  
12 surface which is to be stripped need not be one which can be  
13 placed inside of a conventional induction oven. Rather, a  
14 stripping head suitable for the particular stripping project  
15 can be maneuvered into just about any space and juxtaposed to  
16 just about any surface which is to be stripped. The to-be-  
17 stripped item or surface need not be enclosed nor juxtaposed  
18 with massively sized equipment. This makes induction-based  
19 stripping possible in contexts never before conceived as  
20 possible, and will enable certain industries (the caustic  
21 chemical transport industry, and particular) to save many  
22 hundreds of thousands (or millions) of dollars and man-hours  
23 each year by rapidly accelerating the process of removing worn

1 or damaged protective coatings or linings. As mentioned  
2 earlier, replacing currently used stripping methods with those  
3 made possible by the present invention also yields safety and  
4 health dividends for workers, employers, and insurers.

5 Use of any system 10 according to the present invention  
6 is straightforward. One merely insures that the stripping  
7 system 10 is properly assembled with fittings secured and  
8 coolant flowing through the tubing 26, activates power supply  
9 12, and juxtaposed his the selected stripping head 20, 22, or  
10 24 to the item or surface to be stripped. Once the item or  
11 surface has heated to a sufficient degree that the to-be-  
12 stripped material releases or sloughs off to the desired  
13 degree, the stripping head is removed and the system shut  
14 down. In the case of a large to-be-stripped surface (such as  
15 that of a rubber-lined rail car or tank truck) one cyclically  
16 passes stripping heads 22 or 24 (preferably 24) over segments  
17 of the surface much as if one were ironing a garment. This  
18 process continues until the entire lining has been  
19 sufficiently loosened.

20 It should be emphasized that, however simple the  
21 equipment design taught herein may be, the use of such  
22 equipment in certain contexts mentioned before yields  
23 staggering benefits. For example, stripping a rubber-lined

1 rail car, tank truck or storage tank through use of the  
2 present equipment and method, rather than through use of the  
3 presently used methods of burning, chiseling, or chemically  
4 stripping the lining away have already been proven by the  
5 present inventor to dramatically reduce the required time for  
6 a stripping operation and to reduce exposure of workers to  
7 deleterious substances or conditions.

8 Although the invention has been described with reference  
9 to specific embodiments, this description is not meant to be  
10 construed in a limited sense. Various modifications of the  
11 disclosed embodiments, as well as alternative embodiments of  
12 the inventions will become apparent to persons skilled in the  
13 art upon the reference to the description of the invention.  
14 It is, therefore, contemplated that the appended claims will  
15 cover such modifications that fall within the scope of the  
16 invention.